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GROWTH OF DOUGLAS-FIR, PONDEROSA PINE, AND WESTERN LARCH SEEDLINGS FOLLOWING SEED TREATMENT WITH 30 PERCENT HYDROGEN PEROXIDE

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ABSTRACT

Seeds of the three species were either cold stratified or soaked for 2 hours in 30 percent hydrogen peroxide. Subsequent growth of potted seedlings from treated and stratified seeds was measured at the end of 7 weeks and 1 year. Average size of 1-year-old western larch from H_2O_2-treated seed was significantly less than those from stratified seed. In most instances, height growth, needle length, and ovendry weight of year-old Douglas-firs and ponderosa pines also tended to be less for seedlings from peroxide treated seed. Thus, use of 30 percent H_2O_2 for speeding germination in operational sowings is not recommended.

INTRODUCTION

Hydrogen peroxide treatment has speeded germination of conifer and shrub seeds (Shearer and Tackle 1960, Trappe 1961, Stein 1965, Riffle and Springfield 1968). In view of this effect, Carter and Jones (1962) and others have suggested that H_2O_2 treatments might be used in nursery or direct seeding practice to shorten the time ungerminated seeds are exposed to fungi, seedeaters, or unfavorable weather. In fact, H_2O_2 at 40-volume strength has already been used in a nursery sowing of *Pinus elliottii* and *Pinus taeda* (Takacs 1964). Before H_2O_2 treatment is used extensively on nursery- or field-sown seed, its effect on growth of tree seedlings needs checking. Information is presented on yearlong growth in the laboratory of seedlings germinated from stratified seed and seed treated with 30 percent H_2O_2.

BACKGROUND

Effects of H_2O_2 on seed germination and seedling development were noticed at least as early as 1908 during work on wheat seed sterilization (Miége 1908). Subsequent sterilization studies on bunt-contaminated wheat seed revealed that germinative energy declined as treatment concentration of H_2O_2 increased (Olgyay 1936). Germinative capacity declined also but to a lesser extent. Weight of wheat plants grown 10 days from seed treated with 15 to 30 percent H_2O_2 ranged from 6 to 33 percent less than weight of plants from untreated seed.

Growth of very young tree seedlings was also reduced by seed treatment in H_2O_2 (Dhillon and Johnson 1962). After 18 to 22 days, hypocotyls of western larch seedlings from seeds treated with 3 percent H_2O_2 for 24 hours were only 42 percent as long as those of seedlings from stratified seeds.

METHODS

Seed from two sources each of Douglas-fir (*Pseudotsuga menziesii* (Mirb.) Franco) and ponderosa pine (*Pinus ponderosa* Laws.) and one source of western larch (*Larix occidentalis* (Nutt.)) were used. Those seeds serving as a control were soaked in water for 24 hours, surface dried, and stratified in sealed jars for 4 weeks at 34° F. Those given H_2O_2 treatment were taken directly from cold storage and soaked in twice their volume of 30 percent H_2O_2 for 2 hours.

Control and treated seeds were germinated together in a Precision Scientific germinator[1/] operated at 20° and 30° C. for 16 and 8 hours per day, respectively. Seedlings with radicles of similar size from stratified and peroxide treated seeds were then paired and planted in 8-inch clay pots. Four pairs, one from each seed source of Douglas-fir and ponderosa pine, were potted together in each of six pots. Having germinated more slowly, eight pairs of western larch seedlings were later potted together in each of two additional pots. All seedlings were grown on a laboratory bench at room temperature under 16 hours of light daily from fluorescent and incandescent lights. Water was supplied as necessary.

Cotyledon length and length of hypocotyl from cotyledonary node to soil were measured on each 7-week-old seedling. Seedlings were then depotted, and all those with roots still intact were repotted individually in paper containers and grown for an additional 10 months.

[1/] Use of trade names does not constitute endorsement by U.S. Department of Agriculture.

Height growth, needle length, and total dry weight were determined for each year-old seedling. Height was measured from the cotyledonary node to tip of the terminal bud. Individual ponderosa pines burst bud an unequal number of times, so the youngest needles on different plants were not equally mature. For this reason, lengths were measured on the oldest fascicled needles. Measurements were made on Douglas-fir needles located immediately above the cotyledons for the same reason. On western larch, measurements were taken on needles located midway between terminal bud and cotyledonary node where their length seemed to be maximum regardless of seedling height. Weights were determined after seedlings were dried to constant weight at 70° C.

Analysis of variance techniques were used to compare effect of treatment on hypocotyl and cotyledon lengths of 7-week-old seedlings of all three species. Data for 1-year-old western larch seedlings were also subjected to statistical analyses, but due to the small sample, data for Douglas-fir and ponderosa pine were not.

RESULTS

Both hypocotyl and cotyledon length of 7-week-old seedlings from H_2O_2-treated seed tended to be shorter than of those from stratified seed (table 1). The data show a nearly consistent trend,

Table 1.--*Average hypocotyl and cotyledon length of 7-week-old seedlings from stratified and H_2O_2-treated seed*

Species and seed source	Hypocotyl		Cotyledon	
	Stratified	H_2O_2	Stratified	H_2O_2
	Millimeters			
Douglas-fir:				
Wenatchee National Forest	55.5	47.5	26.7	18.7
Mount Baker National Forest	53.3	46.8	28.2	23.8
Both sources	54.4	47.2	27.4	21.2
Ponderosa pine:				
Umpqua National Forest	52.2	43.8	50.8	43.7
Deschutes National Forest	43.2	41.2	48.3	41.7
Both sources	47.7	42.5	49.6	42.7
Western larch:				
Flathead National Forest	20.4	20.5	16.8	16.6

but in only three comparisons was significance demonstrated statistically at the 95-percent confidence level or better. Differences in treatment means for both seed sources together were significant for hypocotyls of Douglas-fir and cotyledons of ponderosa pine, and highly significant for cotyledons of Douglas-fir. Both seed sources of Douglas-fir or ponderosa pine tended to respond similarly to the hydrogen peroxide treatment.

Average size of 1-year-old western larch seedlings from H_2O_2-treated seed was significantly less than those from stratified seed (table 2). Height growth, needle length, and ovendry weight of seedlings from seed treated with H_2O_2 averaged 7.4 centimeters, 1.1 centimeters, and 0.45 gram less, respectively.

In most instances, height growth, needle length, and ovendry weight of year-old Douglas-firs and ponderosa pines from both seed sources also averaged less from peroxide treated seed.

DISCUSSION AND CONCLUSION

Results of this small study support and extend results of earlier laboratory work which showed that H_2O_2 treatment of seed reduced subsequent hypocotyl growth of western larch seedlings (Dhillon and Johnson 1962). Though nursery or field growth of conifer seedlings from H_2O_2-treated seed has not yet been reported, it appears likely that such treatment will adversely affect subsequent growth of some species. Thus, until adverse growth effects can be eliminated, use of H_2O_2 for speeding germination in operational sowings cannot be recommended.

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Table 2.--*Average height growth, needle length, and ovendry weight of 1-year-old seedlings from stratified and H_2O_2-treated seed*

Species and seed source	Seedlings		Height growth		Needle length		Ovendry weight	
	Stratified	H_2O_2	Stratified	H_2O_2	Stratified	H_2O_2	Stratified	H_2O_2
	------*Number*-----		----------*Centimeters*----------				------*Grams*------	
Douglas-fir:								
Wenatchee National Forest	3	5	12.9	9.0	1.9	1.6	0.80	0.45
Mount Baker National Forest	4	3	16.2	11.8	2.0	1.9	.99	.71
Ponderosa pine:								
Umpqua National Forest	4	3	10.2	9.3	9.9	9.9	1.30	1.03
Deschutes National Forest	3	3	8.0	7.2	10.4	7.3	1.21	.76
Western larch:								
Flathead National Forest	12	8	19.4	12.0	3.4	2.3	1.06	.61

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